Docket Q01-1002-US1

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Sheng (Ted) Tai Tsao	Group Art Unit: 2141
Serial No.: 10/001,735	Examiner: Bayard, Djenane
Filed: Oct. 23, 2001	**Declaration Under 37 CFR § 1.131**
For: Using NAS Appliance to Build a Non-Conventional Distributed Video Server	

DECLARATION OF SHENG TAI TSAO
SWEARING BEHIND REFERENCE
(37 CFR § 1.131)

Commissioner for Patents
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

Dear Sir/Madam:

PURPOSE OF DECLARATION

This declaration is to establish completion of the invention in the present application in the United States, at a date prior to Aug. 3, 2001, that is the effective date of the prior art US Patent Application No. 2003/0033308 to Patel et al., that was cited by the Examiner.

The persons making this declaration is the inventor of U.S. Application Serial No. 10/001,735.

FACTS AND DOCUMENTARY EVIDENCE

To establish the date of completion of the invention of this application, the following attached documents are submitted as evidence:

[X] disclosure documents

Invention disclosure document that I prepared and then filed with the intellectual property department of Quantum Corporation, my employer at the time of the invention described in U.S. Application Serial No. 10/001,735. The invention disclosure document describes the invention in U.S. Application Serial No. 10/001,735. The invention disclosure document states the date of conception as at least as of January 2000. I prepared and filed the invention disclosure document with my then employer Quantum Corporation on May 10, 2000, as routine procedure for inventor employees of Quantum Corporation.

From these documents, it can be seen that the invention in U.S. Application Serial No. 10/001,735 was made at least as early as January 2000, which is a date earlier than the effective date of US Patent Application No. 2003/0033308, *viz* Aug. 3, 2001.

DILIGENCE

Although diligence is not expressly an issue, the Applicant of the present application offer the fact of filing of U.S. Application Serial No. 10/001,735 on Oct. 23, 2001, as sufficient evidence of diligence in "constructive reduction to practice" of the invention.

TIME OF PRESENTATION OF THE DECLARATION

This declaration is submitted prior to final rejection, and is submitted with a response to a first Office Action dated Jan. 13, 2005.

DECLARATION

As a person signing below:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code , and that

such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE

Full name of sole or first joint inventor	Inventor's signature	Date
Sheng Tai Tsao	Sheng Tai Tsao	5/2/2005
Residence and Post Office Address		**Citizenship**
2979 Heidi Drive, San Jose, California 95132		US

Q0(- 1002
rec'd 5/10/00
group: NS
Sub. matter: AV

1.0: TITLE:

Using NAS Appliance to Build a Non-Conventional Distributed Video Server.

2.0: Summary:

While the traditional multi-processors based video server are powerful but they are very expensive. With the advancement of technologies in the area of network and network appliance, now it is possible to build up a non-conventional distributed video server based on network appliance such as Quantum's Snap server, which is less expensive yet powerful to deliver thousands or millions of concurrent video streams to end users. An estimated cost per video stream can be delivered could be under $200 dollar.

3.0: Inventorship:

a) Who:

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Phone # (O) 408-232-6746 (H) 408-251-0864
Employee # 9342
Dept. # 52810
E-Mail Address: Ted.Tsao@quantum.com. Wyu53@msn.com
Date of Conception: 1/2000
Date of Reduction to Practice: 4/2000.

4.0: The Invention:

A) Purpose:

To deliver huge number of concurrent video streams to end users at very low cost.

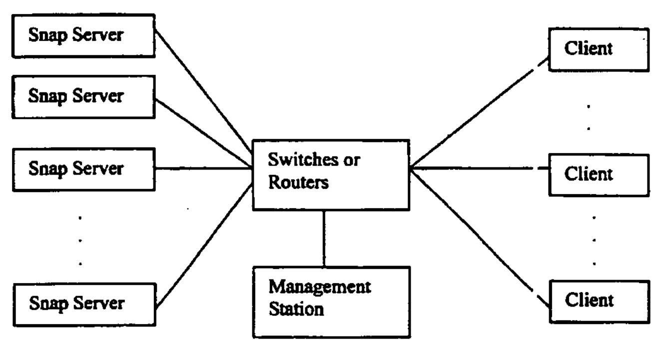
B) Background:

a) Problems Need to be Solved:

There are several types of video server. Some of video servers used multi-nodes SMP machine. This type of machine usually has poor performance when number of the CPU scales up. Because couples or more of CPU may share a common memory, this causes the memory bus contention between different CPU. Some of video server use multi-node MPP machine, CPU on this type of machine usually does not share common memory, however, they may commonly support a distributed file system on top of group of nodes and the video contents is stored on the file system. The video server on a node will be heavily rely on communication channel to receive request from client and to deliver video contents stored on distributed file system to the client. Therefore, it requires coordination between the nodes through intra-node communication channel. Sometime the communication channel between nodes will become a bottleneck. Besides, these video server are very expensive. The minimum per video stream cost is around $400 dollar.

C) To Use NAS Appliance to Build a New Type of Distributed Video Server:

The proposed distributed video server will consist of the numbers of Snap server being clustered together by switches or routers. Each Snap runs independently without support a distributed file system between them, hence there is no need to have intra-nodes communication between each individual Snap servers. However, it requires a dedicated video server management station, the IP switches or routers. By adding these equipment, the cost per stream will increase, however, the increased cost will be fractional if the large number of streams were delivered to the customer. The following simplified figure shows how this type of server can be built up to meet the video server requirement mentioned above.



The basic idea behind this is that let the management station hosts the video server's Web site to perform the administration works and distributes a group of client's requests to a specific NAS server up to the maximum concurrent video streams that it can deliver. Actually, the management station maps a fixed number of clients to a specific NAS server and let each server deliver the video streams directly to a group of clients. The management station also may install with a PCI video-capturing card or attached with external video capture equipment. To replicate video contents from management station to multiple Snap servers becomes an administration task. Let us assume that we try to build up an online Movie Theater with 500 seats and to see that how does this distributed video server will works.

First, the Web host (management) station will accept reservation up to 500 clients before the scheduled movie starts. It then assigns maximum number of client, which corresponding to the maximum number of video stream a single Snap server can deliver, to a server. The management station also sends back to each client a token (a ticket) indicates which server the client has subscribed. When the time is up, the client should automatically start to retrieve video stream based on the token received. Meanwhile, a specific Snap server should authenticate the client based on the information received from management station and deliver the video contents directly to the client station. Further, a

large scale of a movie theater chain can be built up based on the number of small-scale satellite online movie theater distributed among different regions.

5.0: **Related Invention:**

6.0: **Commercialization/Publication**
See Attached Proposal:

7.0: **Others Involved In Project:**
None

8.0 Signatures:
Signature: S.T. Tsao
Date: 5/4/2000

Use NAS Appliance to Build a Distributed Video Server
(A Preliminary Plan)

Ted S.T. Tsao
Quantum Corporation
4/10/2000

1: Background Information:

1.1: The Discovery of the Quantum Snap Property For Playing Video:

During working in S3U group, I wrote a network scalable parallel stressed/load test for the purpose of testing a demo AVID block data server on NAS of S3U. After transferring to Snap division, I have used the same test to run performance measurement testing against the Snap server. By looking at the test log, which resulted from the running multiple concurrent client test threads against a snap server, it is found that each client threads got almost same amount of data throughput rate, which provided by the Snap server. This means that each client threads can share equal amount of data bandwidth provided by Snap server. For example, if the Snap can provide 6Mbyte/sec data throughput on an 100BaseT Ethernet interface, two client threads testing will allow each threads got nearly 3.0Mbyte/sec of throughput. Also, three client threads testing will allow each threads got nearly 2.0Mbyte/sec while four client threads testing will let each client thread got 1.5Mbyte/sec and so on. I was aware of that this is a very important property for a video server, which needs to deliver multiple equal rate of concurrent video streams out to the multiple end users such as 3Mbits/sec or 6Mbits/sec per video streams.

1.2: $126 Per Video Streams Provided By Snap Server:

The other questions came out to my mind are that if the Snap can be actually used for playing video, and how many concurrent video streams a single Snap server can provide, what is the price for an individual video stream provided by the Snap. With these questions in mind, I started to use my spare time to investigate these issues with my home video equipment. First, I put MPEG video clip on it and play the video by using MS MediaPlayer. It works since it supports many different type of media file. From the NSPTL testing results, the average Snap 2000(133MHZ Pentium CPU/32MB memory) can provide 5.6Mbyte/sec on a 100baseT Ethernet interface. From here we can predict that if we run 3.0mbits/sec per video stream, the Snap roughly can provide 15 concurrent video streams. If the Snap 2000 sale price is 1899.00, each video stream delivered by the Snap 2000 is $126. Due to the limited workstations available, three workstations are used for experimental works. Let each station start three concurrent MediaPlayer against same video source on a single Snap. Also, let the total of nine video streams on three workstation start to play at the same time so that each video streams can be retrieved from same cached video source. The nine video streams play very stable. My preliminary conclusion from this experiment is that the original prediction is basically correct and possibly the Snap server can be used as video server.

1.3: The Video Server on the Current Market:

With explosive growth of the Internet, the interactive multimedia market is poised for rapid growth. The media server system plays a critical role in this

market such as video server. There are many types of video server on the market now such as IBM's VideoCharge and Video Streammer on RS/6000(SMP) and on SP system (MPP), the nCUBE's Media Cube 30, 300, 3000(MPP, distributed file system solution), and the Concurrent Computer's MediaHawk Xstreams etc. The nCUBE's Media Cube 3000 can deliver 20000 concurrent video streams. However, the price per stream is pretty high, probably in the range of **$1000 - $2000** per video stream. The actual number needs to be verified.. There is no information on video server from IBM. Most notably, the Concurrent Computer claims to provide lowest price per video stream on the market by their MediaHawk Xstreams. The average per video stream price is between **$700** to **$800** depends on the configuration. Their Ethernet based solution is **$379** per streams. Therefore, compare the Snap server's $126 per video stream to other vendor's solution, the Snap server could potentially position itself to play a significant role in the video server market. Nevertheless, with current implementation of the Snap server, it can not be truly used as a video server since it lacks of a complete customer solution. However, even with additional cost add up for a complete solution, the Snap Server still can provide the lowest cost for per streams. The following section will discuss what are the requirements that will let Snap server becomes a true video server.

2. The Requirements of a Video Server:

2.1: The Basic Requirements:

2.1.1. Provide concurrent video streams.

As discussed in section 1.1 and 1.2, the Snap can provide 15 concurrent video streams if 15 client access the same video source at the same time. This is good in terms of supporting business application such as online Movie Theater, or online educational training class etc. To support true video on demand (VoD), the number of the concurrent video streams a Snap can support will drop significantly due to the random access requests from each client. In a extreme case, it may forces the Snap to getting data from disk for each client in most of time instead of get data from file system's buffer cache. From the NSPLT test and experiment, the Snap can provide 4 concurrent stable video streams in a situation very close to the extreme case. This implies that a Snap can support minimum 4 different movies to 4 different clients at the same time. More experiments may be required to establish a VoD access model. However, it is possible to provide a new scheme to redistribute the random requests from different clients to different Snaps to avoid access different video contents on a single Snap, specially in dealing with video on demand. I will discuss the solution in section 2.3.

2.1.2. Volume capacity.

A 1 hour 3Mbits/sec steam video movie may require 1.8GB of disk space (3Mbits * 3600 + overhead in RAID or file system => 1.35GB + overhead). A 20GB Snap 2000 may roughly store 11 hours movie. A 120GB Snap 4000 can store 66 hours video. With 6Mbits/sec video stream, the number of hours video movie can be stored will be reduced to the half of the number mentioned above. For video server, this is good enough to store 3 to 4 movies on the machine. A video server may be connected to a video archive to access huge volume of video contents.

2.1.3. Video contents management.

The video contents management need to include to list the video sources stored on Snap, to arrange a specific video source to be served for clients, to copy or encode the video source on Snap, or accept reservation for client who subscribe the video etc..

2.1.4. Video contents encoding.

The video contents encoding could be done by using the off the shelf products such as either a PCI video capture card or an external video capture equipment, which installed or connected to the video server management station.

2.1.5. Scalability.

The key solution for a video server's success is its scalability. This will allow the video server to support a wide range of business from small to large. In section 2.3, I will describe a solution to let the Snap server become a scalable distributed video server, which can provide almost unlimited video streams.

2.1.6. Network Interfaces.

Currently the Snap provides IP/Ethernet connection. So the IP switch/router could be used to deliver the video contents from Snap to the PC user. Also, the Ethernet to ADSL router could be used to deliver the video contents from Snap to the TV station with a set Top box. In the future, it may need to investigate other network interface for delivering the video contents to the end users.

2.1.7. Fault handling.

It is critical for a video server to provide fault handling. A preliminary scheme will be discussed in the following section.

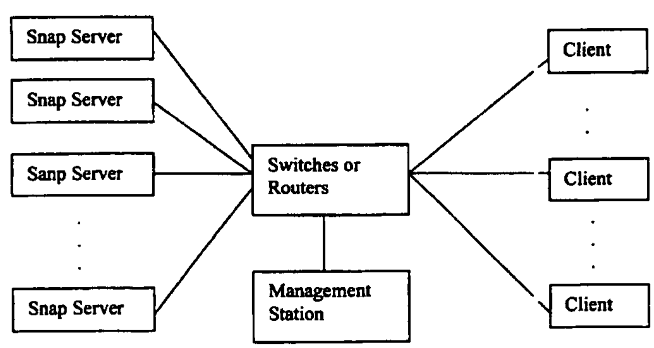
3. The Proposed Distributed Video Server:

3.1: The Classes of the Video Server:

There are several types of video server. Some of video servers used multi-nodes SMP machine. This type of machine usually has poor performance when number of the CPU scales up. Because couples or more of CPU may share a common memory, this causes the memory bus contention between different CPU. Some of video server use multi-node MPP machine, CPU on this type of machine usually does not share common memory, however, they may commonly support a distributed file system on top of group of nodes and the video contents is stored on the file system. The video server on a node will be heavily rely on communication channel to receive request from client and to deliver video contents stored on distributed file system to the client. Therefore, it requires coordination between the nodes through intra-node communication channel. Sometime the communication channel between nodes will become a bottleneck.

3.2: The Non-Conventional Distributed Video Server:

The proposed distributed video server will consist of the numbers of Snap server being clustered together by switches or routers. Each Snap runs independently without support a distributed file system between them, hence there is no need to have intra-nodes communication between each individual Snap servers. However, it requires a dedicated video server management station, the IP switches or routers. By adding these equipment, the cost per stream will increase, however, the increased cost will be fractional if the large number of streams were delivered to the customer. The following simplified figure shows how this type of server can be built up to meet the video server requirement mentioned above.



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streams that it can deliver. Actually, the management station maps a fixed number of clients to a specific NAS server and let each server deliver the video streams directly to a group of clients. The management station also may install with a PCI video-capturing card or attached with external video capture equipment. To replicate video contents from management station to multiple Snap servers becomes an administration task. Let us assume that we try to build up an online Movie Theater with 500 seats and to see that how does this distributed video server will works.

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3.1: The Support of Video on Demand:

To support VoD for 2 to 3 different video contents should be relatively easy to accomplish since a single Snap 2000 can contain as many as 11hours 3Mbits/sec video contents. The video server management station could assign specific client request for a specific video content to a group of Snap server while assign other group of client requests for other video contents to other corresponding groups of Snap server.

To truly support video on demand such as support view of a specific video from an archived video library, where thousands of video contents are stored, a more complicated infrastructure are required. First, the proposed video server must be connected to a video archive storage and be able to retrieve the desired video at any time. Second, a single Snap server may be dedicating to serve such a specific requirement. An infrastructure based on access pattern may need to be investigated to meet such needs.

3.2: The Fault Handling:

The Snap 2000 can be configured with RAID1 while Snap 4000 can be configured with either RAID1 or RAID5. This provides data protection on the disk against fault of a single disk. In the case of Snap servers network fault, a spare Snap must be ready to take the assigned workload off the fault Snap server. The management station must consistently monitor all Snap's operation. The ratio between the number of spare Snap and the total number of Snap need to be calculated. Since this is a preliminary discussion for the fault handling, other faults is not in the scope of this discussion.

3.3: The advantages:

The advantage of this approach is obvious that is simple. The off the shelf Snap can be used directly to deliver video streams to the clients. The only major works needed is for management software on management station. It is scalable. To deliver more streams, just add more Snap servers and switches/routers. The number of streams can be delivered is almost unlimited It is efficient. Since each Snap server is running independently without sharing anything with other, there is no bus contention problem like multi-node SMP system has. In addition, there is also no communication bottleneck between nodes like MPP system has due to no needs for intra-node routing and communication. The per stream price is low if the large number of streams were delivered to the end users even at the added the additional cost of management station and routes/switches. We can deliver our video server bellow the **$200** per video streams, which is about half price of Concurrent Computer's Xstreamer and well bellow the current lowest price on the market.

4. The Video Server Development:

4.1: The Development Goals:

- Phase 1: Setup a development environment and determine the initial management station's platform.
- Phase 2: Build a proto-typed video server.
- Phase 3: Initial product demo.
- Phase 3: Build a commercial video server and beta testing.
- Phase 4: Go to the market.
- Phase 5: More development.

4.2: The Resource Requirement:

a) Engineer requirement:
Besides myself, initially two additional software engineers are required. More persons are required at different stages of product development.

b) Equipment Requirement:
I have inherited some equipment from former S3U group. However, this is not enough. Some additional workstations, video capture equipment, and others may be required.

4.3: The Dependencies:

Initially this video server relies on Snap server product, therefore, the support from Snap server division is required.

4.4: The Schedules:

a) Phase 1: 3 months.
b) Phase 2 and phase 3: 6 months.
c) Phase 4: 4 months.

d) Other phases: TBD.

5. The Business partner:

At the various product development stages, we may establish our business partner with various vendors to expand our product lines and to expand our market presence.

6. The Conclusion:

With the rapid growth of Internet, the needs for deliver multimedia on the Internet are growing. While the traditional video (multimedia) servers are powerful but they are very expansive. With the advancement of technologies in the area of network and network appliance, now it is possible to build up a non-conventional distributed video server based on network appliance such as Quantum's Snap server, which is this also will allow us to build up a new computation model for a new type of server which is different from the traditional server based on SMP or MPP architecture.